

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of)	
)	
WiMAX Forum Petition for Rulemaking)	RM-11793
to Adopt AeroMACS Service Rules)	

To: Wireless Telecommunications Bureau

**COMMENTS OF
THE BOEING COMPANY**

The Boeing Company (“Boeing”) provides these comments on the petition for rulemaking (“Petition”) that was filed by the WiMAX Forum seeking the adoption of service rules for licensees in the aeronautical mobile service (“AMS”) using the Aeronautical Mobile Airport Communications System (“AeroMACS”).¹ Boeing is a strong supporter of AeroMACS. Boeing has participated in the development of AeroMACS, contributing, for example, its expertise² and aircraft for AeroMACS field tests.³ A significant public interest need exists for AeroMACS. In order to move hundreds of aircraft and tens of thousands of people through each of our major airports on a daily basis in a safe and efficient manner, tremendous amounts of data must be processed and shared among aircraft flight systems and crews, air traffic controllers, airport operations staff, and airline personnel. AeroMACS offers the possibility of distributing

¹ See *WiMAX Forum Petition for Rulemaking to Adopt AeroMACS Service Rules*, RM-11793 (March 31, 2017) (“*Petition*”).

² See, e.g., “*Aeronautical Mobile Airport Communications System (AeroMACS) Status Briefing Presentation to WG-M/18, Montreal, Canada*,” July 18, 2011, by Brent Phillips, Federal Aviation Administration, at 15 (noting Boeing’s participation in RTCA standards development for AeroMACS).

³ See, e.g., “*AeroMACS System Characterization and Demonstrations*,” March 2013, by Robert Kerczewski, *et al.*, at 2 (NASA/TM—2013-216497) (noting the use of a Boeing corporate 737 jet equipped with an AeroMACS antenna for the first communication test).

aeronautical safety communications data using wireless broadband capabilities that can support high speed interactions, live video communications, and wide area data processing.

Although Boeing supports the deployment of AeroMACS at major airports throughout the United States, Boeing believes that it is premature for the Commission to propose service rules for AeroMACS, particularly pursuant to the minimalist framework proposed by the WiMAX Forum. Critical issues must first be resolved regarding the manner in which AeroMACS will share the 5091-5150 MHz band with the Aeronautical Mobile Telemetry (“AMT”) service at those airports that are used for flight tests of new aircraft. Additional consideration is also necessary regarding the obligation of AeroMACS to protect Earth-to-space feeder links operating in this spectrum with the Globalstar mobile-satellite service (“MSS”) system. Each of these issues necessitates further study that must be completed prior to initiating a rulemaking to consider the adoption of service rules for AeroMACS.

I. THE SPECTRUM SHARING CONDITIONS BETWEEN AEROMACS AND AMT FLIGHT TESTING RAISE UNIQUE CONCERNS THAT MUST BE RESOLVED

As the Commission is aware, the 5091-5150 MHz band is allocated on a primary basis to AMS both to support AeroMACS and AMT flight test transmissions from aircraft.⁴ The United States advocated for the AMT allocation during WRC-07 in recognition of the critical need for additional AMT spectrum to support the increasingly data intensive flight tests that are required to certify modern commercial aircraft, and in acknowledgement of the loss of AMT spectrum in other frequency bands.

⁴ See Amendment of Parts 1, 2, 15, 25, 27, 74, 78, 80, 87, 90, 97, and 101 of the Commission’s Rules Regarding Implementation of the Final Acts of the World Radiocommunication Conference (Geneva, 2007) (WRC-07), Other Allocation Issues, and Related Rule Updates, ET Docket No. 12-338, ET Docket No. 15-99, and IB Docket 06-123, *Report and Order, Order, and Notice of Proposed Rulemaking*, 30 FCC Rcd 4183, ¶ 51 (2015) (“WRC-07 Order”).

As the Commission has recognized, the spectrum requirements for flight test telemetry continue to increase in terms of bandwidth capacity, noise floor limitations and geographic reach. Flight test maneuvers have become more sophisticated and far greater amounts of data must be collected in real time to protect the safety of flight crews and to efficiently bring new aircraft to market. Test aircraft are generally flown at significant speeds and require safe maneuvering room, necessitating large and varied geographic areas for flight test operations.

Although the 5091-5150 MHz band is allocated to both AeroMACS and AMT flight testing, the conditions for spectrum sharing between the two services are not self-evident. AeroMACS involves a complex network of relatively short communications paths between fixed and mobile transmitters and receivers at airports, while AMT flight testing will use the 5091-5150 MHz band to transmit relatively weak signals from often distant test aircraft to AMT receivers at the airport. The ITU adopted power limits to ensure that the AMT transmissions from test aircraft do not interfere with AeroMACS.⁵ Comparable measures were not identified, however, to protect AMT flight test receivers from nearby AeroMACS transmitters. Instead, the measures that will be necessary to protect AMT flight test receivers from AeroMACS communications require further study.

In raising this issue, Boeing acknowledges that, at NTIA's request,⁶ the Commission gave AeroMACS "priority" over AMT in the use of the 5091-5150 MHz band.⁷ This is because AeroMACS is strictly limited to aeronautical mobile (route) services ("AM(R)S")

⁵ See 47 C.F.R. § 2.106, n.US444B(a)(2) (requiring AMT aircraft-to-ground transmissions to comply with the power limits indicated in Annex 1 of ITU Resolution 418 (Rev. WRC-12)).

⁶ See Letter from Paige Atkins, Associate Administrator, Office of Spectrum Management, NTIA, to Julius P. Knapp, Chief, Office of Engineering and Technology, FCC, ET Docket No. 12-338, at 1-3 (Feb. 11, 2015) ("*NTIA Letter*").

⁷ See *WRC-07 Order*, ¶ 60; 47 C.F.R. § 2.106, n.US444B(b) (2016).

supporting safety and regularity of flight.⁸ Neither NTIA nor the Commission, however, sought to preclude the use of the 5091-5150 MHz band for AMT flight testing. Instead, NTIA urged operators of AeroMACS and AMT systems “to cooperate with each other in the exchange of information about planned deployments of their respective systems so that the prospects for compatible sharing of the band are enhanced.”⁹ This same intent was codified by the Commission in its rules.¹⁰

Certain factors potentially enhance the ability for spectrum sharing between AeroMACS and AMT flight testing in the 5091-5150 MHz band. For example, such sharing will be necessary only at those airports where flight testing is conducted. The Commission has previously identified the relevant airports.¹¹ Commercial flight tests that will require use of the 5091-5150 MHz band, however, now also occur in additional airport locations. Fortunately, the Commission acknowledged in its WRC-07 implementation order that additional airports may become candidates for spectrum sharing between AeroMACS and AMT flight tests and agreed that such additional facilities would be included on a case-by-case basis.¹²

Second, although the spectrum requirements for AMT flight testing – like AeroMACS – are significant and growing, flight test operations at these airports could likely be accommodated using a relatively limited portion of the 5091-5150 MHz band. Thus, the overall impact of

⁸ See *WRC-07 Order*, ¶ 38, n.91.

⁹ *NTIA Letter* at 2-3.

¹⁰ See *WRC-07 Order*, ¶ 60; 47 C.F.R. § 2.106, n.US444B(b) (2016) (instructing that operators of AM(R)S and AMT systems at the relevant airports “are urged to cooperate with each other in the exchange of information about planned deployments of their respective systems so that the prospects for compatible sharing of the band are enhanced”).

¹¹ See *WRC-07 Order*, ¶ 56; 47 C.F.R. § 2.106, n.US444B(c) (2016).

¹² See *WRC-07 Order*, ¶ 60.

AMT operations on AeroMACS usage will be limited and, given the relative size of most of the airports in question in terms of annual passenger traffic, should not be burdensome.

Most importantly, however, further study remains necessary regarding the manner in which spectrum sharing can be accomplished. There has been only limited field testing of AeroMACS and AMT compatibility, such as testing that was conducted in Toulouse, France in 2015.¹³ Although the results of those tests were encouraging, they did not firmly determine how much physical spacing will be needed between AeroMACS transmitters and AMT receivers based on varying AeroMACS transmit power levels. The tests also did not firmly determine whether a guard band will be needed between channels used by AeroMACS and those employed by AMT, or whether adequate protection can be achieved using filters on AMT receivers, directional antennas for AeroMACS, or other technical and logistical methods.

Boeing believes that it is critical to resolve these issues before service rules are proposed or a licensing framework established for AeroMACS in the United States. For example, it is not yet known whether the base station EIRP limits proposed by the WiMAX Forum in Section 87.608 of its proposed rules are compatible with AMT at a reasonably close distance. Although the proposed power limits are reflected in the ICAO SARPS for AeroMACS, Boeing does not believe they were developed with any consideration of sharing with AMT flight testing.

In addition, the WiMAX Forum has proposed that some AeroMACS transmitters be permitted “slightly off airport property.”¹⁴ Boeing is concerned that such an exception may be used to permit the operation of relatively high-power AeroMACS transmitters at relatively high

¹³ See “*AeroMAC Final Verification Report*,” Single European Sky AMT Research (“SESAR”) Joint Undertaking, Project Number 9.16_Edition 00.02.00 D11 (April 23, 2015) *available at* https://www.sesarju.eu/sites/default/files/solutions/03_VR_Solution_102_9.16-D11-AeroMACS_Final_Verification_Report.pdf (*last visited* Aug. 9, 2017).

¹⁴ *Petition* at 8 n.22.

locations (such as on an adjacent building or hill). This seems inconsistent with the underlying concept of AeroMACS as involving a tight network of relatively low-site, low-power transmitters and receivers. It may also encourage the use of AeroMACS systems for airport communications that are not directly related to the safety and regularity of flight, as required by its AM(R)S allocation. Therefore, the Commission should encourage the completion of testing between AeroMACS and AMT and refrain from initiating a rulemaking on service rules for AeroMACS until the results of those studies have been analyzed.

II. THE COMMISSION SHOULD ENSURE THAT THE OVERALL FRAMEWORK FOR AEROMACS DEPLOYMENT IN THE UNITED STATES IS CONSISTENT WITH THE AGGREGATE INTERFERENCE RESTRICTIONS TO PROTECT MSS FEEDER LINKS

Although not mentioned in the WiMAX Forums petition, a significant issue exists with respect to the manner in which AeroMACS can protect the Earth-to-space feeder links for the Globalstar MSS system, which also operates in the 5091-5150 MHz band. The protection framework adopted by the ITU effectively requires that the total aggregate power from all AeroMACS installations must not exceed interference thresholds for the feeder link receivers on the Globalstar spacecraft.¹⁵ As experts on AeroMACS have recognized, this restriction places “a significant limitation on the total system capacity of AeroMACS”¹⁶ and the deployment of AeroMACS systems without first adequately addressing this issue “will eventually lead to a saturation of AeroMACS capacity.”¹⁷

¹⁵ See Report ITU-R M. 2118, “Compatibility between proposed systems in the aeronautical mobile service* and the existing fixed-satellite service in the 5 091-5 250 MHz band” (2007).

¹⁶ See “*Considerations for Improving the Capacity and Performance of AeroMACS*,” March 2014, by Robert Kerczewski, *et al.*, at 3, *included within* Proceedings of IEEE Aerospace Conference 2014, Big Sky, Montana (2014).

¹⁷ *Id.* at 6.

Because of this critical issue, consideration is being given within the aviation industry to designing AeroMACS installations in a manner that minimizes transmissions towards space. The Commission should ensure that such interference mitigation measures are adequately identified, validated, and incorporated in the service rules that are eventually proposed by the Commission for AeroMACS in the United States. In this manner, “testing and validation of these concepts and updating of AeroMACS standards can be completed before saturation occurs.”¹⁸

III. THE COMMISSION SHOULD ENSURE THAT ANY CHANNEL MANAGER DESIGNATED FOR AEROMACS HAS ADEQUATE EXPERIENCE WITH CRITICALLY IMPORTANT AVIATION COMMUNICATIONS SERVICES

The WiMAX Forum proposes in its Petition that a Channel Manager be identified to process non-federal applications to operate AeroMACS facilities at airports in the United States.¹⁹ The Channel Manager would also work with airports, the FAA, AMT licensees and the Aerospace and Flight Test Radio Coordinating Council, Inc. (“AFTRCC”) – which is the coordinating body for federal and non-federal AMT users – regarding the sharing of the 5091-5150 MHz band between AeroMACS and AMT at the airports where flight tests are conducted.²⁰

Boeing supports the concept of a Channel Manager and agrees with the WiMAX Forum that the qualifying criteria that the Commission should employ in choosing the manager should ensure that it can successfully accomplish its functions “in a fair and efficient manner.”²¹

¹⁸ *Id.* at 6.

¹⁹ *See Petition* at 15.

²⁰ *See id.* at 16.

²¹ *Id.* at 21.

Arguably the single most critical factor in assessing such qualifications would be significant expertise and experience in the management and operation of aeronautical communications systems intended for safety and regularity of flight. The aviation industry – with the full support of ICAO, the FAA, and the FCC – requires that all communications systems used for aviation safety purposes include robust and redundant measures to ensure their reliability and continuous availability. Any entity chosen as the AeroMACS Channel Manager should have deep experience in this heritage of ensuring safety above all else.²²

Boeing also supports the proposal to have an industry advisory board oversee the activities of the Channel Manager.²³ Any such advisory board, however, should include broad representation across the aviation industry, including representation by aircraft manufacturers that conduct flight test operations in the 5091-5150 MHz band.

As part of the Channel Manager’s duties, Boeing would support a framework in which, once an agreement is reached on the division of the 5091-5150 MHz band between federal and non-federal users, the Channel Manager would be able to assign channels to non-federal users without further coordination or review by NTIA or the FAA. Thus, based on the recommendations of the Channel Manager, the Commission could issue licenses to non-federal users without submitting those license applications to NTIA or the FAA for review or approval.

In addition, Boeing supports the concept of having the Channel Manager work with AFTRCC on spectrum sharing between AeroMACS and AMT in the 5091-5150 MHz band. Boeing questions, however, whether the Channel Manager will need to work directly with AMT

²² Although Boeing would consider other candidates as well, Boeing believes that Aviation Spectrum Resources, Inc. (“ASRI”) may be the best candidate for Channel Manager.

²³ *See Petition* at 22.

licensees (potentially collecting coordination fees from them, according to the Petition²⁴), rather than solely with AFTRCC as their representative. This is the same framework that the Commission adopted for MBANs, creating a coordinating body for MBANs users and directing that body to work with AFTRCC with respect to protecting AMT licensees. Such an approach would arguably be more efficient.

IV. THE COMMISSION SHOULD NOT ADOPT A LICENSE BY RULE APPROACH FOR A CRITICAL PUBLIC SAFETY SERVICE

The Petition proposes that AeroMACS operators be licensed “by rule” using the Citizens Band Radio Service exception that exists in Section 307(e) of the Communications Act.²⁵ Boeing does not believe that a licensed by rule approach would be appropriate for a critical safety of life service, particularly one that is required to share spectrum with other services. As the Commission recently observed, licensing by rule is warranted when it can “allow for rapid deployment of small cells by a wide range of users, including consumers, enterprises, and service providers, at low cost and with minimal barriers to entry.”²⁶

These are not appropriate goals for AeroMACS, a safety of life service that must include strict eligibility requirements for licensees (consistent with those proposed by the WiMAX Forum²⁷), and careful coordination of each AeroMACS transmitter to ensure that they do not interfere with other AeroMACS links – particularly links operated by the FAA for air traffic

²⁴ See *id.* at 22.

²⁵ See *id.* at 15 (citing Part 95 of the Commission’s rules and 47 U.S.C. § 307(e)).

²⁶ See Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, *Report and Order and Second Further Notice of Proposed Rulemaking*, 30 FCC Rcd 3959, ¶ 15 (2015).

²⁷ See *Petition* at 18-19.

management – or with other authorized users of the 5091-5150 MHz band and safety services potentially operating in the same spectrum.


Therefore, although Boeing would endorse the use of a streamlined licensing approach, Boeing firmly believes that an individual license should be required for each AeroMACS user with the location of transmitters recorded in the Commission's Universal Licensing System and available for reference by both federal and non-federal users of the band that may be concerned about potential interference. This is the manner in which other fixed aeronautical communications services are authorized pursuant to Part 87 of the Commission's rules and AeroMACS should be no exception.

V. CONCLUSION

Boeing supports the deployment of AeroMACS at airports in the United States in order to enhance the safety and efficiency of aircraft operations. Boeing believes, however, that it is premature for the Commission to propose service rules for AeroMACS licensees until additional spectrum sharing and interference issues are addressed and incorporated in the AeroMACS standards that are being developed by the aviation experts and industry participants.

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